TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
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Residual Stand Density and the Early Development of Northern Hardwood Reproduction in Upper Michigan

The establishment of desirable reproduction is fundamental to the successful application of all-aged management in selectively cut northern hardwood stands. Although reproduction of tolerant species is often present in uncut stands, the seedlings need additional light for further growth. Seedling establishment and development can best be regulated by manipulating overstory density.

In 1951 the Lake States Forest Experiment Station began a stocking level study in the northern hardwood type of Upper Michigan. Variations in residual stand density were obtained by cutting to stocking levels of 30, 50, 70, and 90 square feet of basal area per acre in trees 10 inches d.b.h. and larger. These levels cover the range of residual stand density commonly observed in partially cut mature northern hardwood stands. Prior to cutting, the percentage species composition in the study area was as follows: sugar maple 77, yellow birch 14, beech 5, red maple 3, and other hardwoods 1.

Reproduction counts were made 2 and 5 years after the stand had been cut to the specified stocking levels. Seedlings were tallied in two size classes: class 1 for trees 6 to 35 inches tall, and class 2 for trees 3 feet tall to ½ inch d.b.h. Sprouts were combined with seedlings since they accounted for only 1 percent of the class-1 trees and 4 percent of the class-2 trees. Saplings 1 to 4 inches d.b.h. were also tallied to provide a complete picture of reproduction development.

Reproduction summaries showed that:

1. Sugar maple was the predominant species, accounting for about 90 percent of the seedlings and 75 percent of the saplings regardless of year of measurement. Yellow birch comprised 3 percent of the class-1 seedlings at 2 years and 8 percent at 5 years. But at both dates only 1 percent of the saplings and class-2 seedlings were yellow birch.

2. The density of the residual stand had no significant effect upon the total number of seedlings present at either 2 or 5 years after logging. There was, however, a significant increase in the number of seedlings under all densities during the 2- to 5-year period. Class-1 seedlings increased less than 25 percent, but class-2 seedlings increased as much as 170 percent (table 1). Similar increases in the percentage of quadrats stocked were also observed.

3. Residual overstory density had no significant effect on the percentage of quadrats stocked with sugar maple seedlings (table 2). However, the stocking of yellow birch seedlings was significantly greater in stands cut to 30 or 50 square feet than in stands with denser overstories.

4. The amount of sapling reproduction was not significantly affected by residual stand density (table 3).

This study showed that there was an increase in the number of seedlings and saplings from 2 to 5 years following logging. For yellow birch, residual stand densities of 30 and 50 square feet of basal area gave a greater increase in percentage of stocked quadrats than did denser overstories. Residual stand density had no effect upon the percentage of quadrats stocked with sugar maple, nor did it affect the total number of seedlings and saplings present at either measurement.

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(over)

Table 1.--Summary of seedling reproduction 2 and 5 years after logging, by size class and residual stand density
(Thousands of trees per acre)

Years since logging	Size class[1]	Stand density in square feet of basal area			
		30	50	70	90
2	1	26.6	26.7	27.9	21.5
	2	2.9	2.9	2.5	3.1
5	1	31.1	30.5	30.1	26.2
	2	6.0	7.8	6.8	4.6
Percent increase	1	17	14	8	22
	2	107	169	172	48

1/ Size class 1 - Seedlings 6 to 35 inches tall
Size class 2 - Seedlings 3 feet tall to ½ inch d.b.h.

Table 2.--Percentage of quadrats stocked with seedlings by species, size class, residual stand density, and years since logging

Species and size class[1]	Stand density[2] 2 years after logging				Stand density[2] 5 years after logging			
	30	50	70	90	30	50	70	90
Sugar maple								
Class 1	86	86	90	82	91	88	96	89
Class 2	22	28	27	25	50	57	59	37
Red maple								
Class 1	6	5	6	12	8	7	9	14
Class 2	0	2	1	5	3	5	4	5
Yellow birch								
Class 1	10	11	4	7	25	24	9	19
Class 2	0	1	1	0	3	3	1	0
Beech								
Class 1	4	2	4	10	2	1	1	9
Class 2	3	1	1	6	5	1	2	8
Other hardwoods								
Class 1	5	4	6	5	4	2	5	4
Class 2	2	1	2	1	3	3	2	3

1/ Size class 1 - Seedlings 6 to 35 inches tall
Size class 2 - Seedlings 3 feet tall to ½ inch d.b.h.
2/ In square feet of basal area per acre

Table 3.--Summary of sapling reproduction 2 and 5 years after logging by tree size and residual stand density
(Number of trees per acre)

Diameter breast high (inches)	Years since logging	Stand density in square feet of basal area			
		30	50	70	90
1	2	90	52	81	101
	5	160	103	186	179
2	2	35	34	47	31
	5	55	44	55	39
3	2	20	16	21	27
	5	35	30	34	27
4	2	20	10	16	13
	5	10	12	14	16
Total	2	165	112	165	172
	5	260	189	289	261
Percent increase		58	69	75	52